

Technical Information Bulletin

U.S. Department of Labor
Occupational Safety and Health Administration



Potential for Natural Gas and Coal Dust Explosions in Electrical Power Generating Facilities

TIB 00-11-06

Purpose

The purpose of this Technical Information Bulletin is:

1. to remind employers who operate electrical power generation facilities about potential explosion hazards during boiler start up, operation, and shut-down;
2. to provide guidance to the Occupational Safety and Health Administration (OSHA), and State Plan Compliance Safety and Health Officers regarding prudent practices established by the National Fire Protection Association (NFPA) and the American Society of Mechanical Engineers (ASME) for the safe operation of boilers and furnaces in electrical power generating facilities; and
3. to provide guidance to safety professionals who serve the power generation industry including consultants, insurance auditors, and others who provide services and equipment to the industry.

Background

The State of Michigan is one of 23 States that have chosen to retain authority for occupational safety and health law enforcement under a State Plan approved by OSHA. Therefore, the General Industry Safety Division (MIOSHA), under the Bureau of Safety and Regulation (BSR), Michigan Department of Consumer and Industry Services (CIS), investigated a power plant explosion in 1999 that resulted in 6 fatalities and 14 serious injuries. The primary explosion resulted from an unintentional natural gas buildup in the furnace of an idle power boiler and was followed by a secondary explosion of disturbed coal dust. MIOSHA found coal dust

This TIB is not a new standard or regulation, and it creates no new legal obligations. It is advisory in nature, informational in content, and is intended to assist employers in providing a safe and healthful workplace.

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accumulations throughout the powerhouse on ledges, structures, and equipment. This boiler was fired with natural gas, coal, and blast furnace gas to produce steam to power the turbines.

Jurisdictional Issues

Both MIOSHA and the Boiler Division of the Michigan Bureau of Construction Codes responded following the explosion. The Boiler Division had limited jurisdiction and could investigate only the wet-side of the boiler (i.e., the pressure vessel in which the steam is generated). MIOSHA had jurisdiction over all other aspects of the matter including compliance with MIOSHA regulations -- e.g., R408.18602 (adopting the Federal OSHA standard, 29 CFR 1910.269 on Power Generation), and R408.18502 (adopting the Federal OSHA Standard, 29 CFR 1910.147 on Lockout/Tagout); R408.1011 (a), MIOSHA's analogue to Federal OSHA's General Duty Clause, Section 5 (a)(1) of the *OSHA Act*, (P.L. 91- 596 December 29, 1970, and its amendments).

Incident Description

Based on interviews and observations, and after reviewing relevant documentation, the investigators developed a chronology of events leading to the explosion. Employees were taking the boiler offline in preparation for its annual licensing inspection. Prior to the time of the explosion, blast gas and pulverized coal systems were eliminated as fuel sources, and maintenance personnel were blanking the two main 10-inch natural gas lines.

Power Service Operators (PSOs) were required to shut up to 30 natural gas valves, including pilots, ignitors, and burners located on two different floors. Maintenance personnel blanked, disconnected, and/or capped 6 of the 30 natural gas lines and valves. PSOs monitored induced draft, forced draft, primary fans, steam pressure, temperature, and water levels during the shut down. During this process, PSOs failed to close one of the two 10 inch main natural gas shutoff valves feeding the burners. As a result, natural gas was trapped between shutoff valves and burner control valves, and the burner control valve subsequently was reopened to vent the trapped gas into the furnace box. This allowed the natural gas at line pressure to flow into the furnace box for approximately 2 minutes. The primary explosion occurred when this gas encountered ignition sources, such as hot or smoldering ash in the superheater or generating tubes, or possibly a spark from the electrostatic precipitator. A secondary explosion resulted from disturbed coal dust dispersed during the initial explosion.

Investigation Findings

The investigators identified the following engineering control and work practice deficiencies, which were cited under the Power Generation and the Lockout/Tagout Standards, as well as the General Duty Clause:

- Lack of adequate combustion controls:
Inoperative flame monitor and burner safety devices .
- Lack of burner/ignitor control system:
Inoperative pilot ignitors. Pilots were lit with a glove soaked in alcohol.
- Purging of natural gas into an idle furnace:
The natural gas valve train not equipped with a

double block and bleed to atmosphere.

- Lack of proper identification of isolation valves, butterfly valves, pilot valves, and ignitor valves:
Valves were improperly marked or indentified, and improperly located for boiler shutdown and startup operations.
- Failure to establish proper written procedures for startup/shutdown of boilers:
Written procedures are necessary due to personnel changes associated with shift assignments, the complexity of boiler shutdown, and the infrequency of shutdowns,
- Failure to control accumulations of appreciable coal dust:
Poor housekeeping allowed coal dust to accumulate throughout the facility (e.g., on floors, ledges, structures, beams and equipment).
- Failure to institute proper lockout procedures specific to boilers:
No specific procedures for boilers or for release from lockout; lockout devices were not identified during blanking operations.
- Failure to conduct adequate/effective job briefings:
Employee briefings were not conducted prior to the boiler shutdown. Briefings would have revealed that two employees had not performed this task within the last year and that employees needed to be retrained.
- Failure to provide adequate training, procedures, and certifications of proficiency for employees assigned to boiler operations.

The investigators also found that individual departments within the powerhouse handled safety-related issues. This produced a situation where safety issues potentially went unrecognized and where information regarding safety was not necessarily shared with the appropriate personnel. For example, insurance audits and engineering studies recommending modifications to combustion/safety controls were viewed as operational issues without consideration for, or input from, the safety department.

Recommendations

The investigators concluded that this accident may have been prevented if industry standards such

as those identified below, had been followed:

- (1) NFPA 8502, “Standard for the Prevention of Furnace Explosions/Implosions in Multiple Burner Boilers;”
- (2) NFPA 8503, “Standard for Pulverized Fuel Systems;”
- (3) ASME, BPVC Section VII, “Recommended Guidelines for the Care of Power Boilers;” and
- (4) ASME B31.1, “Power Piping.”

NFPA Standard 85B, “Standard for Prevention of Furnace Explosions in Natural Gas-Fired Multiple Burner Boiler-Furnaces,” which was an earlier version of NFPA 8502, Section 2-1.3(b), identified “fuel leakage into an idle furnace and the ignition of the accumulation by a spark or other source of ignition” as one of the most common explosive conditions in connection with the operation of a boiler-furnace. Based on the evidence in the case file for this investigation, the MIOSHA/OSHA investigative team recommends that:

1. When boilers are manually operated in lieu of automated combustion/safety controls, additional emphasis must be placed on work practices. Necessary elements for emphasis include written operating procedures, job briefings, verification checklists, training, proficiency testing, and maintenance of training records.
2. When equipment nears the end of its useful life, the employer must be particularly diligent, as well as vigilant, with respect to maintenance. Boiler safety controls (e.g., flame monitors) must be operational and well maintained.
3. Coal dust accumulations must be recognized as a serious hazard and housekeeping must be performed with diligence to control and/or limit coal dust accumulations.
4. To ensure safety there must be clear lines of communication among all power plant entities, including: the safety department, employee safety and health representatives, security department, maintenance, operations, and management. A comprehensive safety committee representing all these organizational functions is essential.

Important Information on the Nature and Effect of Technical Information Bulletins

OSHA’s Directorate of Technical Support (DTS) issues Technical Information Bulletins (TIBs) to provide information about occupational hazards and/or to provide information about noteworthy, innovative, or specialized procedures, practices and research that relate to occupational safety and health. DTS selects topics for TIBs from recognized scientific, industrial hygiene, labor, industry, engineering, and/or medical sources.

The *Occupational Safety and Health Act* requires employers to comply with hazard-specific safety and health standards. In addition, employers must provide their employees with a workplace free from recognized hazards likely to cause death or serious physical harm under Section 5(a)(1), the General Duty Clause of the Act. Employers can be cited for violating the General Duty Clause if there is a recognized hazard and they do not take appropriate steps to prevent or abate the hazard. However, the failure to implement TIB recommendations is not, in itself, a violation of the General Duty Clause. Citations can only be based on standards, regulations, and the General Duty Clause.

Further information about this bulletin may be obtained by contacting OSHA’s Directorate of Technical Support at 202-693-2200